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EFFECT OF MERCURIC SULPHATE AND CADMIUM SULPHATE ON THE OXYGEN CONSUMPTION AND RATE OF OXYGEN CONSUMPTION IN ESTUARINE CRAB *SCYLLA SERRATA*

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ABSTRACT

Physiological responses oxygen consumption of estuarine crab Scylla serrata were exposed to the sub-lethal concentration of cadmium sulphate and mercuric sulphate for the present investigation up to 24, 48, 72, 96, 120 hrs (17.2mg/L, 6 mg/L), respectively. The oxygen consumption was initially slight increased (24 hrs) and then decreased throughout the experiment in both the treated groups as compared with control group.

KEY WORD-Scylla serrata, Cadmium sulphate, Mercuric sulphate

Introduction

The environment is complex and diverse. Both living and non-living elements of environment are dynamic in nature and show temporal as well as partial variations. They are interacting with one other. In the last three decades of 20th century an unending industrial growth, increasing population and faster urbanization has increased pollution.

Test animals selected for the present study was the crab *Scylla serrata*, common estuarine crab which is commercially important and available in large quantities throughout the year.

. Respiration is an endless oxidative process in a living animal resulting in consumption of oxygen and production of Carbon dioxide for oxidation of cell and production of energy. The rate of oxygen consumption is reflection of the total metabolism and the metabolic rate of aquatic animal. Changes in oxygen consumption have been measured as response to toxicants (Jen *et al.*, 2010). The rate of oxygen consumption by an animal under different experimental condition is a good index of metabolic activity to face the environmental stresses. There are number of variables such as body size, sex, pH of medium, physiological condition, starvation, (Raghunathan, 1999; Shobha Rani, 1999; Spanopoulos-Hernandeza *et al.*, 2005).

Total oxygen consumption is one of the indicators of the aquatic organisms. It is useful to assess the physiological state of organisms. Hence the analysis of oxygen consumption can be used as biodetector to evaluate the basic damage influence on the animals. The objects of the

present study was to evaluate the effect of heavy metals Cadmium Sulphate and Mercuric Sulphate on oxygen consumption and rate of oxygen consumption on crab Scylla serrata during 24, 48, 72, 96 and 120 hours respectively

Aquatic respiratory organs increase diffusion surface area by extension of tissues of gills that project out into the water. The great increase in diffusion surface area provided by gills enables aquatic organisms to extract far more oxygen from water than would be possible from their body surface, alone gill provide a greatly increased surface area for gas exchange.

In crustacean gill is enclosing in branchial chambers which provide a means of pumping water. The branchial chamber lies between the bulk of the body and the hard exoskeleton of the animal this chamber contain gills and0020wopen to the surface beneath a limb movement of limb drawn water through the branchial chamber thus creating currents over the gills

Stock animals and acclimation

The animals were brought to the laboratory as a single stock for each complete bioassay. They were acclimated to the laboratory conditions for a week prior the bioassay tests during which they were maintained in large aquaria containing filtered sea water. During acclimation water in the aquaria was changed daily and animals were fed on bivalve pieces. Only healthy animals were subjected to bioassays at the end of the successful acclimation, those healthy looking and approximately of uniform size, weight were selected the tests.

Material and Method

The crab Scylla serrata used in the present experiment were collected from Shiroda in single stock .They were acclimate to the laboratory conditions for a week prior the bioassay tests during which they were maintained in large aquaria containing filtered sea water. The animals were exposed to sub-lethal concentrations of cadmium sulphate and mercuric sulphate for 24, 48 72, 96, 120 hrs. (17.2 mg/L, 6 mg/L), respectively.

For determination of oxygen consumption amber coloured bottles of one liter capacity were used as respirometer. Crab *Sylla serrata* exposed to lethal concentration of toxicants were removed from their respective aquarium and transferred in to this respirometer which were then filled with appropriate dose of Mercury sulphate and Cadmium sulphate with estuaries water. Bottles were completely airtight by capping them with rubber corks and carefully sealing them with molten wax. Side by side control experiment was similar set up except that the respirometer contained unexposed crab and estuarine water without toxicants. Before the commencement of the experiment, the initial oxygen content of estuarine water used as the tests solution was determined.

All the experimental and control bottles were left undisturbed for one hour, after which the water from each bottle was carefully siphoned out to find out its oxygen content. This was done by the Azide modification of the Winkler method (Welsh and Smith, 1959). The difference in the oxygen contents of the pre-experimental and post-experimental was measure of the oxygen consumed by each crab exposed to Mercury sulphate and Cadmium sulphate. Oxygen consumption by crab in the control was similarly determined. All these experiment were conducted during morning. After each experiment all these crabs were weighed individually and released into their respective test aquaria. The data was subjected to suitable statistical test.

RESEARCH FINDINGS AND ANALYSI

Effect of Cadmium Sulphate on the oxygen consumption and rate of oxygen Consumption in Esturine crab *Scylla serrata*

Sr No	Duration of Exposure	Weight of Animal	Total Oxygen Consumption in CC of O2/ animal/hr	Rate of Oxygen Consumption in CC of O2/gm/ weight
01	**Control**	42	2.250 ± 0.07	0.053 ± 0.07
02	**24 hrs**	43.5	2.82 ± 0.08	0.065 ± 0.09
03	**48 hrs**	43.4	2.542 ± 0.05	0.058 ± 0.06
04	**72 hrs**	43	2.120 ± 0.05	0.049 ± 0.04
05	**96 hrs**	42.6	2.100 ± 0.09	0.046 ± 0.09
06	**120 hrs**	42.6	2.993 ± 0.08	0.44 0.04

Values are means ±SD of six individual observation, p>0.05, p< 0.0 1, p > 0.01 significant when student's test was applied between control and experimental group

Effect of Mercuric Sulphate on the oxygen consumption and rate of oxygen Consumption in Estuarine Crab *Scylla serrata*

Sr No	**Duration of Exposure**	**Weight of Animal**	**Total Oxygen Consumption in CC of O_2/ animal/hr**	**Rate of Oxygen Consumption in CC of O_2/gm/ weight**
01	**Control**	42	2.250 ± 0.07	0.053 ± 0.07
02	**24 hrs**	44	2.738 ± 0.07	0.062 ± 0.08

03	**48 hrs**	43.5	2.010 ± 0.09	0.047 ± 0.03
04	**2 hrs**	42.6	1.88 ± 0.08	0.046± 0.09
05	**96 hrs**	44.4	1.69 ± 0.09	0.038 ± 0.03
06	**120 hrs**	44	1.24 ± 0.11	0.028 ± 0.01

- Values are means ±SD of six individual observation, p>0.05, p< 0.0 1, p > 0.01 significant when student's test was applied between control and experimental group

Figure 2.1a :- Effect of Cadmium sulphate on oxygen Consumption in crab *Scylla serrata*

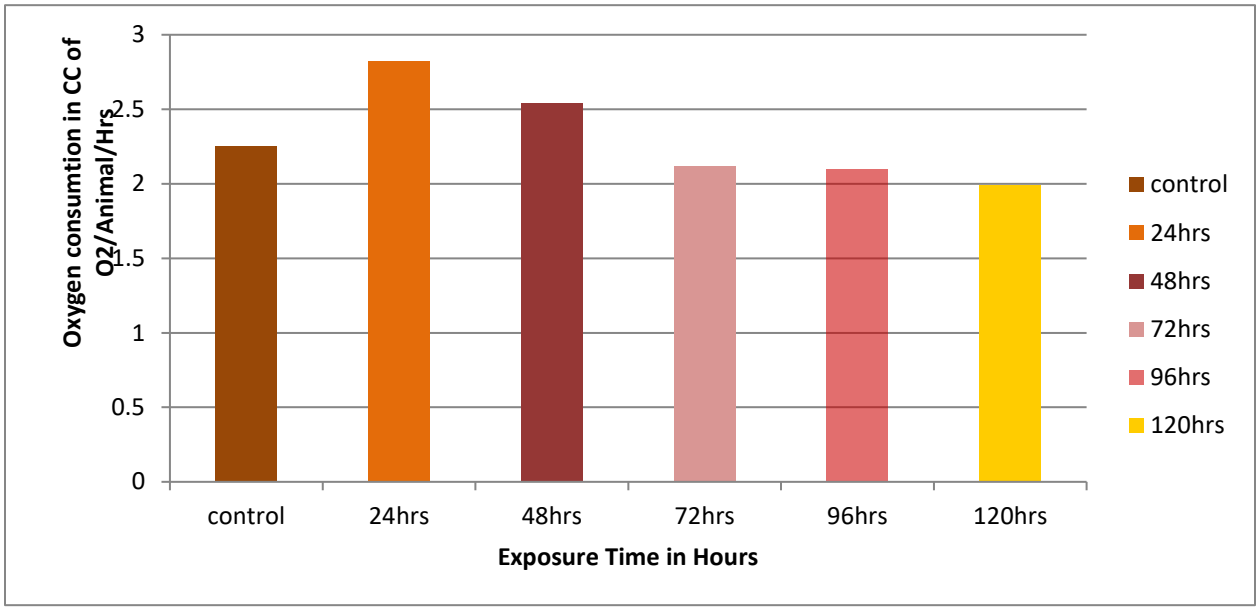


Figure 2.1b:- Effect of Cadmium sulphate on total oxygen Consumption in crab *Scylla serrata*

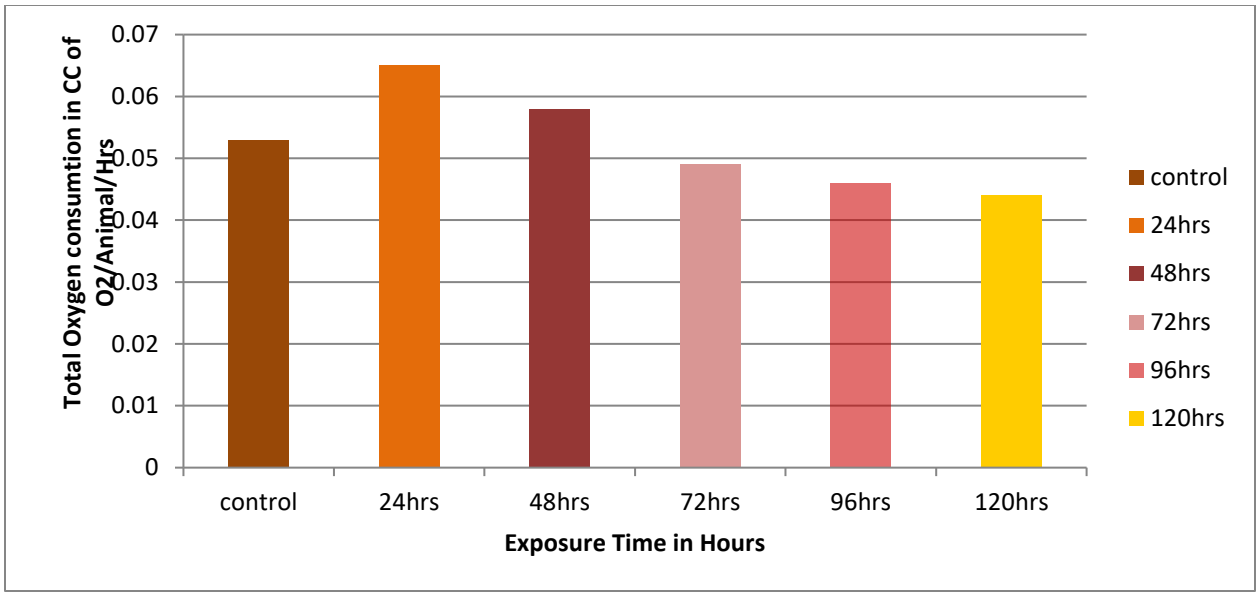
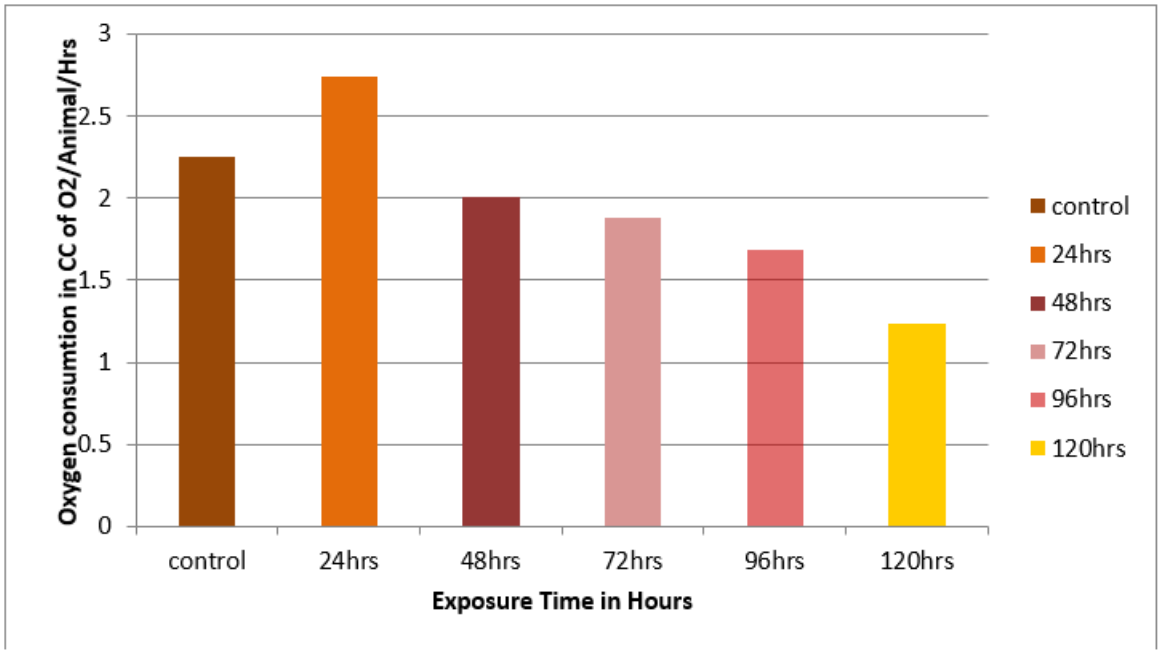


Figure 2.2b:- Effect of mercuric sulphate on oxygen Consumption in crab *Scylla serrata*



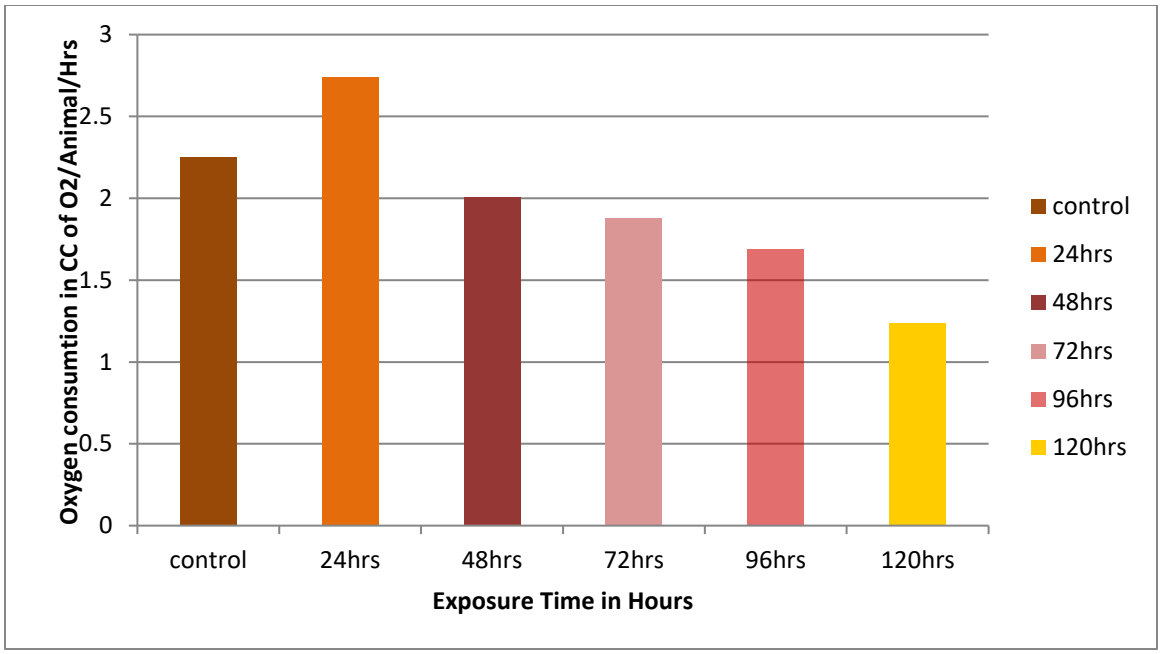
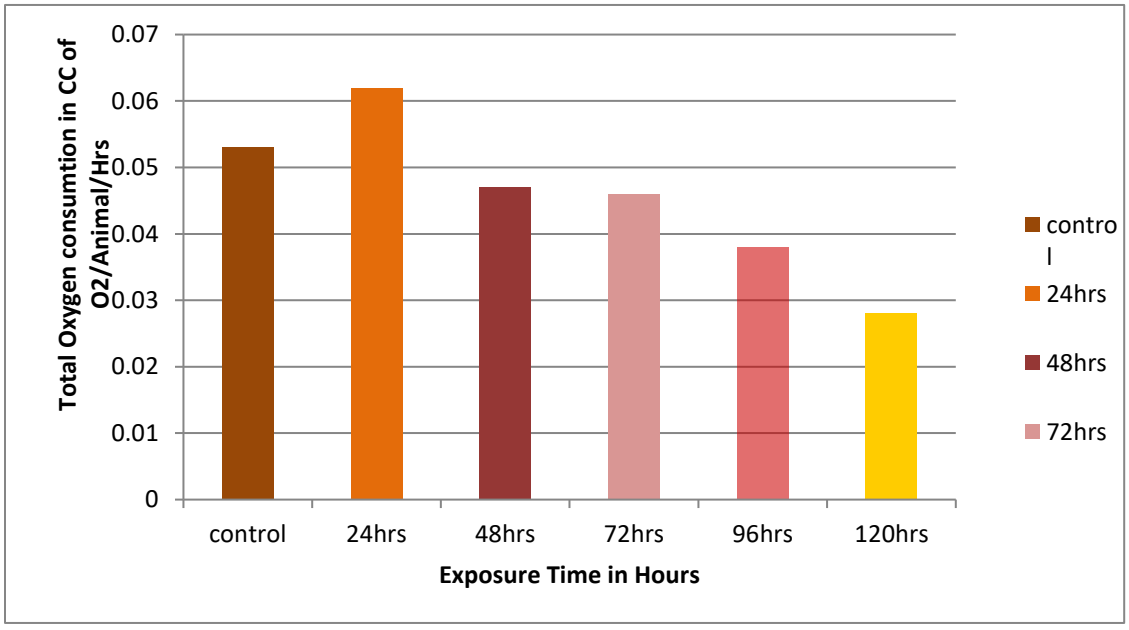


Figure 2.2a:- Effecof mercu

Figure 2.1a :- Effect of Cadmium sulphate on oxygen Consumption in crab *Scylla serrata*



Results

1) : Total oxygen consumption

The total oxygen consumption of crab *Scylla serrata* was altered when exposed to different concentration of cadmium sulphate and mercury sulphate (fig. 3.1a, 3.2a). In present

investigation the total oxygen consumption was 2.250 ± 0.03 CC/animal/hrs for control and 24 hrs (2.820 ± 0.05), 48 hrs (2.542 ± 0.05), 72 hrs (2.120 ± 0.02), 96 hrs (2.100 ± 0.09), 120 hrs. (1.993 ± 0.08) CC/animal/hrs for cadmium sulphate.

Crab *Scylla serrata* exposed mercury sulphate showed (2.250 ± 0.07) CC/animal/hrs for control and 24 hrs (2.738 ± 0.07), 48 hrs (2.010 ± 0.09), 72 hrs (1.883 ± 0.08), 96 hrs (1.698 ± 0.09), 120 hrs (1.245 ± 0.11) CC/animal/hrs.

The result obtained showed that total oxygen consumption was initially slight increased (24 hrs) and then decreased throughout the experiment in both the treated groups as compared with control group. (Table 3.1 & 3.2)

2): Rate of oxygen consumption

The rate of oxygen consumption of crab *Scylla serrata* was altered when exposed to different concentration of cadmium sulphate and mercury sulphate. (fig 3.1b& 3.2b) In present investigation the rate of oxygen consumption was 0.053 ± 0.07 CC/animal/wet weight for control and 24 hrs (0.067 ± 0.09), 48 hrs(0.059 ± 0.06), 72 hrs(0.049 ± 0.04), 96 hrs(0.046 ± 0.09), 120 hrs (0.044 ±0.) CC/animal/wet weight for cadmium sulphate.

Crab *Scylla serrata* exposed mercury sulphate showed 0.053 ± 0.07 CC/animal/wet weight for control and 24 hrs(0.062 ± 0.08), 48 hrs(0.047 ± 0.03), 72 hrs(0.418 ± 0.09), 96 hrs (0.038 ± 0.03), 120 hrs (0.028 ± 0.01) CC/animal/wet weight.

The results indicate that the rate of oxygen consumption was initially slight increased (24 hrs) and then decreased throughout the experiment when compared with control group. (Table 3.1 & 3.2 and fig. 3.1a, 3.1b &3.2a, 3.2b)

DISCUSSION

Most aquatic organisms breathed in the water in which they live. Heavy metal due to rapid industrialization and indiscriminate application pesticides, chemicals, sewage and other effluents containing organic matter are discharged into water bodies, made heavy metals pollution of aquatic ecosystem. Which changes the chemical properties of water and depletion in the oxygen content occurs in the medium and change in respiration rate is common physiological responses to toxicants It is clearly evident from present studies (table 3.1 & 3.2) that cadmium sulphate and mercuric sulphate affected oxygen consumption of crab *Scylla serrata* showed significant decreased (Fig.3.1a, 3.1b & Fig.3.2a, 2b).

The metal induced changes in respiration are complicated and vary from metal to metal and from one experimental condition to others (Mali *et al.,* 2009). Mali and Ambore (2003) studied impact of copper sulphate on the oxygen consumption on fresh water female crab, *Barytelphsa guerini* and reported a significant decrease in the rate of oxygen consumption.

Similar result showed Jadhav *et al*., (2011) on crab *Barytelphsa guerini* exposed to mercuric nitrate. Khan *et al.,* (2000) studied the effect of heavy metals on histological structure of gills of crustaceans and stated that the decline in the rate of oxygen consumption may be result of formation of coagulated mucus over the gills and body surface of the crab.

The rate of Oxygen consumption was found to be decreased with an increased in exposed periods to crab *Barytelphusa guerini* in all the season exposed to heavy metals mercuric chloride and copper sulphate. (Nagabhushanum *et al*., 1991; Machal *et al.*, 1991). Patil *et al*., (2006) observed that the oxygen consumption of fish *Nemacheilus sinuatus* treated sublethal and lethal concentration of *Cestrum diurnum* was decreased with increased in exposure time. This directly or indirectly affects the respiration of the fish. Bharati (2002) reported the gradual decreased in oxygen consumption at higher concentration in edible crab, *Paratelphusa hydrodromous*.

The oxygen consumption of was found to be decreased (Mahajan and Zambare 2005; Pampatwar and Ambore 2004;. Shelke and Wani (2005) reported that the rate of oxygen consumption was found to be decreased in fish *Amblypharyngodon mola* exposure to mercury chloride, cadmium chloride and arsenic trioxide with increased in exposure period. The decreased of oxygen consumption was maximum in chronic exposure as compared to that of acute exposure.

Bishwas and Shrotri (1986) shows decrease oxygen consumption in marine crab *Scylla serrata* when expose to thiodin. Jawle (1986) showed the changes in rate of oxygen consumption of fresh water crab, *Barytelphus guerini* exposure to organophosphorus insecticide ekatin, dimecron and zolone.

Mukkhe *et al.*, (2006) shows that the rate of respiration fresh water crab, *Barytelphus guerini* has found to be altered when subjected to mercuric chloride and copper sulphate. The rate of oxygen consumption decreased throughout experiment in summer monsoon and winter. Monica Kale and Kulkarni (2003) observed that the fish *Rasbora daniconius* subjected to cadmium chloride initial at 3 to 12 hours the rate of oxygen consumption increased and from 24 hours onward the rate of oxygen consumption declined. The initial increased may be due to bioaccumulation of cadmium in body tissue like gills, intestine and muscle.

Logawary and Remia (2009) observed decreased rate of oxygen consumption in fresh water fish T*ilapia mossambica* exposed to cypermithrin and ekalux. Similar result obtained (Shereena et al., 2009; Mohammed *et al.*, 2011). Chebbi and David (2010) studies effect of quinalphos on fingerlings of *Cyprinus carpio* which was altered oxygen consumption due to respiratory stress.

The change in rate of oxygen consumption is a good indicator of the metabolic rate of an organism to face environmental stresses. Oxygen consumption rate decrease considerably

suggesting respiratory stress under toxication, which may alter biochemistry, histochemistry of an organism.

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